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# Trust and trustworthiness under information asymmetry and ambiguity[☆]

Irma Clots-Figueras[a], Roberto Hernán González[b], Praveen Kujal[c,*]

[a] Universidad Carlos III de Madrid, Departamento de Economía, Calle Madrid 126, Getafe 28903, Madrid, Spain
[b] Nottingham University Business School, Jubilee Campus (South Building), Nottingham NG8 1BB, UK
[c] Department of Economics, Middlesex University Business School, The Burroughs, Hendon NW4 4BT, London, UK

## HIGHLIGHTS

- Study the effect of uncertainty and ambiguity in the standard investment game.
- Measures of trust and trustworthiness are robust to both uncertainty and ambiguity.
- Proportion of individuals who send zero is marginally higher (10% significance level) under ambiguity compared to the baseline.

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## ABSTRACT

We introduce uncertainty and ambiguity in the standard investment game. In the uncertainty treatment, investors are informed that the return of the investment is drawn from a publicly known distribution function. In the ambiguity treatment, investors are not informed about the distribution function. We find that both trust and trustworthiness are robust to the introduction of these changes.



## 1. Introduction

Most daily interactions involve elements of uncertainty or ambiguity. For example, a visit to the doctor, the quality of education, or the outcome of a business venture, are situations all characterized by ambiguity.[1] Ambiguity arises when the distribution of returns is not known. Under uncertainty, however, this distribution is precisely known.

In this paper we study how uncertainty and ambiguity impact trust and trustworthiness in the investment game (Berg et al., 1995). The general result from these games (see the meta survey by Johnson and Mislin, 2011) is that on average trust towards strangers is observed and receivers return the amount sent, although the results may depend upon features such as the size of the multiplier, culture, the development of institutions, etc. However, little is known about the robustness of trust in situations with information asymmetry.

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* Corresponding author.
*E-mail addresses:* iclots@eco.uc3m.es (I. Clots-Figueras), Roberto.Hernan@nottingham.ac.uk (R.H. González), pkujal@gmail.com, p.kujal@mdx.ac.uk (P. Kujal).

[1] The distinction between risky and ambiguous outcomes (Keynes, 1921; Knight, 1921) was shown to be relevant by Ellsberg (1961). He found that, in violation of expected utility theory (von Neumann and Morgenstern, 1944; Savage, 1954), individuals, in general, preferred lotteries associated with known rather than unknown probabilities.

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Our experimental design modifies the standard trust game to allow for two types of information asymmetry. In the first variation, the uncertainty treatment, the return of the investment is an equally likely draw from the distribution {2, 3, 4}. In the second variation, i.e. the ambiguity treatment, the investor only knows that the return of the investment is greater than one, and has no other knowledge of the underlying distribution. The information regarding the value of the multiplier in this case is thus ambiguous.[2]

The introduction of information asymmetry does not change the theoretical prediction based on rational and selfish subjects. Even with information asymmetry, investees would return zero and investors would anticipate this and send the same. This may, however, not be the case if behavior is driven by a combination of conditional (reciprocity) and unconditional other-regarding preferences (such as unconditional altruism or inequality aversion; see Cox, 2004). For the same level of investment, investees may perceive a greater level of trust under information asymmetry than under certainty and return a higher amount to investors. Similarly, investors' decisions could be affected by their belief about the actual return of the investment (unknown under information asymmetry, even if they know the distribution of returns). For example, an altruistic investor may send a higher amount if the personal cost is lower (i.e. higher return of investment). Given this, we do not make explicit a priori conjectures about the effect of information asymmetry on trust and trustworthiness.

We find that trust and trustworthiness are mostly robust to the variations introduced to the standard investment game. The number of individuals sending zero is larger under ambiguity, but they are a very small number. However, the overall effect on trust is not significant as the behavior of the majority of the subjects who send a positive amount is not affected by the introduction of information asymmetry.

The paper is structured as follows. Section 2 describes the experimental design. In Section 3 we present the results, and Section 4 concludes.

## 2. Experimental design

A total of 346 undergraduate students from Universidad Carlos III were recruited for an hour. The average payoff was approximately €12.34. Including the instructions, the experiment lasted 45 min. All subjects were given a questionnaire prior to their recruitment. Responding to the questionnaire was a pre-requisite to participating in the experiments. The questionnaire contained personal information about age, studies, grades, family origin etc.

Individuals were randomly selected into sessions and roles were randomly assigned. Senders (investors) and receivers (investees) of the investment game were assigned to separate rooms in the same building before they arrived for the experiment. Senders and receivers were referred to as player A and player B, respectively, and were told that they would be paired with another person (A/B) in a different room.

The following details were common to all treatments. All instructions[3] were computer based. Participants were paid their earnings privately. Both senders and receivers got a 100 dex[4] endowment. The sender could send any amount (M) between 0 and 100 dex to the receiver. The amount received by the receiver was multiplied by $k$. Upon receipt the receiver decided how much to send back to the sender. Below we outline the specific characteristics of each treatment.

**Baseline**: Both senders and receivers were told that $k$ took a value of 3. All information was known by all players.

**Uncertainty**: The sender was told that $k$ could take any value between {2, 3, 4} with equal probability. The receiver knew the actual value of $k$ and was aware that the sender did not know its true value. All this was common information.

**Ambiguity**: The sender was told that $k$ could take any value greater than one, and that the receiver knew the actual value of $k$. All this was common information for both players.[5]

**Table 1**
Descriptive statistics. Trust.

| Average (median) [standard deviation] | Baseline | Uncertainty treatment | Ambiguity treatment |
|---|---|---|---|
| Trust | 0.462<br>(0.500)<br>[0.295] | 0.438<br>(0.300)<br>[0.344] | 0.375<br>(0.350)<br>[0.283] |
| N | 61 | 55 | 57 |

## 3. Results

### 3.1. Trust

The standard measure of trust is the proportion of the endowment that the investor (sender) sends to the trustee (receiver). In Table 1 we report the descriptive statistics of the measure of trust for our treatments. We find that trust is not significantly affected by the introduction of information asymmetry (Kruskal–Wallis, *KW*, $p = 0.3238$). Compared to the baseline, average trust does not change significantly under uncertainty (Mann–Whitney–Wilcoxon, *MWW*, $p = 0.5166$) or ambiguity (*MWW*, $p = 0.1091$). Also, we do not find significant differences between uncertainty and ambiguity treatments (*MWW*, $p = 0.5440$).

We further confirm our results by running OLS regressions in which we regress *trust* on the treatment dummy and several controls, such as year of birth, gender, and dummies reflecting whether the subjects are foreigners and first year students (*freshman*). We also control for session dummies. Our results (Table A1 in Appendix A) confirm that our measure of trust is not significantly affected by the introduction of information asymmetry. We also analyze the behavior of those who send zero and, those who send a positive amount. Interestingly, we observe that the proportion of individuals who send zero (Appendix A, Table A1—column two) is marginally higher (10% significance level) under ambiguity compared to the baseline. However, restricting to those subjects who sent a positive amount we find no treatment differences (Appendix A, Table A1—column three). Given that the proportion of subjects sending zero is relatively small (Baseline: 2 out of 61, 3.3%; Uncertainty: 5 out of 55, 9.1%; Ambiguity: 8 out of 57, 14.0%), we do not find an overall effect on trust as a majority of the subjects (who send a positive amount) do not change their behavior significantly.

**Result 1.** *Trust is unaffected by the introduction of uncertainty and ambiguity. However, the introduction of ambiguity marginally increases the probability that subjects send zero.*

2 Note that we are not comparing uncertainty vs. ambiguity in the Ellsberg (1961) framework.

3 Appendix B.

4 Experimental money.

5 In this treatment the value of $k$ was always equal to 3.

**Table 2**
Descriptive statistics. Trustworthiness.

| Average (median) [standard deviation] | Baseline | Uncertainty treatment | Ambiguity treatment |
|---|---|---|---|
| Trustworthiness | 0.190<br>(0.166)<br>[0.212] | 0.185<br>(0.073)<br>[0.225] | 0.199<br>(0.160)<br>[0.195] |
| N | 59 | 50 | 49 |

### *3.2. Trustworthiness*

In Table 2 we report the descriptive statistics for trustworthiness. Trustworthiness is defined as the percentage returned by the receiver (out of the amount received) to the sender. We find that the average level of trustworthiness is not different across treatments (Kruskal–Wallis, *KW*, $p = 0.7681$). Compared to the baseline, average trustworthiness does not change significantly under uncertainty (*MWW*, $p = 0.7976$) or ambiguity (MWW, $p = 0.5597$). Also, we do not find significant differences between uncertainty and ambiguity treatments (MWW, $p = 0.5153$). A more detailed regression analysis (Table A2 in Appendix A) also reveals no significant effect of uncertainty or ambiguity on trustworthiness. Below we state Result 2.

**Result 2.** *Trustworthiness is unaffected by the introduction of uncertainty and ambiguity.*

## 4. Conclusion

We find that both trust and trustworthiness are robust to the introduction of uncertainty and ambiguity in the standard investment game. The probability of sending zero marginally increases under ambiguity but the majority of subjects, who send a positive amount, do not change their behavior significantly. The fact that trustworthiness is unaffected suggests that receivers are not sensitive to or do not pay attention to the amount of information given to senders.

## Appendix A. Supplementary data

Supplementary material related to this article can be found online at http://dx.doi.org/10.1016/j.econlet.2016.08.019.

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